

IDAHO FISH & GAME DEPARTMENT



LAKE AND RESERVOIR INVESTIGATIONS

F 53-R-2 (1966-1867)

and

F 53-R-3 (1967-1968)

By

Donald J. Welch
Fishery Biologist

February, 1968

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STATE OF IDAHO
FISH AND GAME DEPARTMENT John
John R. Woodworth, Director

FEDERAL AID TO FISH RESTORATION
Job Completion Report
for
F 53=R-2 (1966-1967) and
F 53=R-3 (1967-1968)
LAKE AND RESERVOIR
INVESTIGATIONS

Donald J. Welch
Fishery Biologist
Boise, Idaho

February, 1968

ACKNOWLEDGEMENT

David Heiser, Fisheries Biologist, was Project Biologist in charge of the Arrowrock and Lucky Peak Reservoir Studies during the project year beginning March 1, 1966. Mr. Heiser terminated his employment with the Department on October 27, 1966. The data collected by him in 1966 has been incorporated in this combined annual and job completion report.

TABLE OF CONTENTS

<u>JOB NO. A3</u>	Page
ABSTRACT.....	1
RECOMMENDATIONS.....	2
OBJECTIVES	2
TECHNIQUES USED	2
FINDINGS.....	3
Arrowrock - Species Composition.....	3
Arrowrock - Tributary Survey	4
Lucky Peak - Species Composition	8
Lucky Peak - Tributary Survey	9
Food Habits Study.	9
Management of Arrowrock and Lucky Peak	10
Condition of Game Fish	10
 <u>JOB NO. A6 and JOB NO. AS ABSTRACT</u>	 13
RECOMMENDATIONS	13
OBJECTIVES.....	13
TECHNIQUES USED	13
Water Temperature.....	13
Dissolved Oxygen	13
Water Chemistry.....	15
Plankton	15
FINDINGS.....	15
Water Temperature	15
Dissolved Oxygen	15
Water Chemistry	15
Plankton	27
 LITERATURE CITED.....	 30

LIST OF TABLES

Page

JOB NO. A3

Table 1. Arrowrock Reservoir storage volumes, 1965 through 1967 (acre-feet)	3
Table 2. Percentage composition of fish species in Arrowrock Reservoir based on gill net catches, 1965 through 1967.....	4
Table 3. Gill net catches in Arrowrock Reservoir prior to low pool, 1967.....	5
Table 4. Gill net catch in Arrowrock Reservoir during refill, 1967.....	7
Table 5. Fish killed by explosives in the Middle Fork of the Boise River, 1967...	7
Table 6. Estimated fish kill resulting from underwater explosions, Lucky Peak Reservoir, July, 1962	8
Table 7. Gill net catches in Lucky Peak Reservoir, 1964 and 1967.....	9
Table 8 Percentage by volume of the stomach contents of 356 fish of six species in Arrowrock Reservoir, 1966,.....	10
Table 9. Percentage by volume of the stomach contents of sixteen rainbow trout and fifteen coho salmon in Lucky Peak Reservoir, 1967.....	10
Table 10. Arrowrock Reservoir hatchery fish planting summary, 1950 to 1967.	11
Table 11 Lucky Peak Reservoir planting summary.....	12

JOB NO. A6 and JOB NO. As.

Table 1. Storage volumes of Arrowrock Reservoir, 1965 through 1967 (acre-feet)	21
Table 2. Water chemistry of Arrowrock Reservoir, 1965 through 1967 0	21
Table 3. Water chemistry of Lucky Peak Reservoir, 1966	27

LIST OF FIGURES

	Page
<u>JOB NO. A3</u>	
Figure 1. Map of Arrowrock and Lucky Peak Reservoirs.....	6
<u>JOB NO. A6 and JOB NO. AS</u>	
Figure 1. Map of Arrowrock and Lucky Peak Reservoirs.	14
Figure 2. Temperature profile in Arrowrock Reservoir, 1965.....	16
Figure 3. Temperature profile in Arrowrock Reservoir, 1966.....	17
Figure 4. Temperature profile in Arrowrock Reservoir, 1967.....	18
Figure 5. Temperature profile in Lucky Peak Reservoir, 1966.....	19
Figure 6. Temperature profile in Lucky Peak Reservoir, 1967.....	20
Figure 7. Dissolved oxygen concentrations in Arrowrock Reservoir, 1965	22
Figure 8. Dissolved oxygen concentrations in Arrowrock Reservoir, 1966.....	23
Figure 9. Dissolved oxygen concentrations in Arrowrock Reservoir, 1967	24
Figure 10. Dissolved oxygen concentrations in Lucky Peak Reservoir, 1966.....	25
Figure 11. Dissolved oxygen concentrations in Lucky Peak Reservoir, 1967	26
Figure 12. <u>Daphnia</u> pulses in Arrowrock Reservoir, 1965 through 1967.	28
Figure 13. <u>Daphnia</u> pulses in Lucky Peak Reservoir, 1966 through 1967.....	29

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Idaho
Project No. F 53-R-2 & 3
Job No. A3

Name LAKE AND RESERVOIR INVESTI-
GATIONS
Title Population Manipulation and
Production of Game Fish in
Arrowrock and Lucky Peak
Reservoirs

Period Covered: July 1, 1965 to
February 29, 1968

ABSTRACT

Extensive gill netting in Arrowrock Reservoir indicated that the fish population was quite stable in 1965 and 1966, but that the total number of fish and the species composition changed drastically in 1967 following an extreme drawdown in the fall of 1966. Catch per net-hour decreased from 6.8 in 1966 to 1.8 in 1967. The percent of rough fish in the population dropped from 93 percent in 1966 to 66 percent in 1967. In the same period, the percentage of rainbow trout increased from 3 percent to 18 percent because of continued stocking of hatchery fish in 1967.

The fish population in Lucky Peak Reservoir has remained quite stable since 1964. Trout spawning and rearing areas in Lucky Peak tributaries do not contribute significantly to trout production in the reservoir. The primary spawning areas for Arrowrock are the Middle and South Forks of the Boise River,

Food habit studies on Arrowrock in 1966 showed that suckers fed primarily on zooplankton and that trout, squawfish and yellow perch were primarily fish-eaters. Observations at Lucky Peak in 1967 indicated that zooplankton was the main food item for all species.

RECOMMENDATIONS:

Present management practices should be continued on both reservoirs, i.e., stocking with catchable-size rainbow trout and fingerling coho salmon. Fish planted in Arrowrock should be marked to ascertain the amount of movement through the dam down into Lucky Peak.

Two alternative fisheries management plans are suggested for Arrowrock Reservoir.

1. Draw Arrowrock Reservoir down to approximately 1,000 acre-feet each year. This would drastically reduce the rough fish population. The 1966 and 1967 studies indicate that the plankton population rebound rapidly and would form an abundant food supply for fingerling trout (or coho salmon) in the spring following the drawdown.

Fingerling trout or salmon planted in Arrowrock each spring would encounter an environment with very few predator or competitor species and a good food supply. As shown in these studies, growth to eight or nine inches by fall can be expected and these larger fish should drift into Lucky Peak Reservoir as the water volume decreases.

These larger yearlings can be expected to have a much higher survival rate than the two- to three-inch fingerlings now being stocked in Lucky Peak Reservoir.

A large scale mark-and-recovery test is needed to determine the benefits expected from this plan.

2. The alternative plan is to ask that Arrowrock Reservoir water levels be held as high as possible through each winter. The primary purpose of the storage is for irrigation and water supply and demands probably will continue to result in variable pool levels each summer and winter. Under these conditions rough fish levels will remain high most years and dictate a planting program of catchable-size trout because of poor fingerling survival. The high cost of planting a sufficient number of catchable-size trout to establish a good fishery in a reservoir with very little angling pressure makes this plan of questionable value.

OBJECTIVES:

1. To determine present species composition, distribution, and abundance of fish in the reservoirs.

2. To determine the present utilization of tributary streams for spawning by rough fish, notably suckers.

3. To determine food habits and movements of rough fish in the reservoirs. TECHNIQUES

USED:

Monofilament nylon experimental gill nets were fished on Arrowrock Reservoir in 1965 and on both reservoirs in 1966 and 1967. The nets were six feet deep by 125 feet long and consisted of 25 feet each of 3/4, 1, 1 1/4, 1 1/2, and 2-inch square mesh. Both surface and bottom sets were made.

A physical ground survey was made in 1966 of tributary streams to both reservoirs to determine the presence of and availability to spawning fish. Tributaries of Arrowrock were sampled with explosives in 1967 to determine the presence of rough and game fish which could be significant to recruitment to the reservoir,

Stomach samples were collected from all major species in 1966 and from rainbow trout and coho in 1967. The contents were analyzed for type and volume of material present,

FINDINGS:

Arrowrock - Species Composition

Gill nets were fished for a total of 828 hours in 1965, 1966 and 1967. Species captured included.

Game fish species

Rainbow trout, Salmo gairdneri
Dolly Varden trout, Salvelinus malma
Mountain whitefish, Prosopium williamsoni
Yellow perch, Perca flavescens
Coho salmon, Oncorhynchus kisutch

Nongame fish species

Largescale sucker, Catostomus macrocheilus
Bridgelip sucker, Catostomus columbianus
Squawfish, Ptychocheilus oregonensis
Longnose dace, Rhinichthys cataractae
Speckled dace, Rhinichthys osculatus
Tui chub, Siphateles bicolor
Utah chub, Gila atraria
Redside shiner, Richardsonius balteatus
Chiselmouth, Acrocheilus alutaceus
Sculpins, Cottus sac

(From Key to Oregon Freshwater Fishes by Carl E. Bond)

The fish population remained quite stable in 1965 and 1966, probably due to a high overwinter storage volume being maintained in

Year	High Pool	Low Pool
1965	291,600	79,800
1966	286,000	940
1967	283,500	1,120

During this period the species composition remained stable but an increase in the number of fish was indicated by an increase in catch per net-hour from 3.2 to 6.8. Part of this increase could be due to the use of surface sets only in 1966. The catch data (Table 2) showed a decrease in the percentage of suckers caught and an increase in the percentage of shiners as would be expected for surface sets.

The reservoir was drawn down to a very low level in 1966 (Table 1) and a fish kill due to lack of oxygen was noted (Heiser, 1967). Gill netting in 1967 was aimed, therefore, at assessing the effect of severe drawdowns. A decrease in catch per net-hour from 6.8 in 1966 to 1.8 in 1967 indicated a reduction in the number of fish in the reservoir. The most notable changes in species composition was a reduction of perch from 4 percent in 1966 to 0.29 percent and an increase in rainbow trout from 3 percent in 1966 to 18 percent of net catches. Coho salmon fingerlings were introduced into Arrowrock in April, 1967, and these grew to nearly eight inches by September. They made up 16 percent of the total catch,

Table 2, Percentage composition of fish species in Arrowrock Reservoir based on gill net catches, 1965 through 1967,

Species	1965	1966	1967
Suckers	76	55	49
Redside shiner	4	32	13
Squawfish	6	4	4
Yellow perch	10	4	< 1
Rainbow trout	2	3	18
Dolly Varden	< 1	< 1	< 1
Whitefish	< 1	< 1	< 1
Chiselmouth	0	0	< 1
Coho Salmon	--	--	16
Total net-hours	378	256	194
Catch per net-hour	3.2	6.8	1.8
Number of fish caught	1,212	1,743	345

The reservoir was again drawn down very low in 1967 causing the fish to concentrate as the water level dropped (Table 3). As the water level receded, rainbow trout and coho salmon seemed to be concentrated on the bottom near the dam. Gill nets there caught salmonids almost exclusively. At the same time, gill nets in the upper end of the reservoir, mainly in the arm fed by the South Fork of the Boise River, caught predominantly suckers,

No fish kill was noted at low pool in 1967, and gill net catches during refill (Table 4) indicated that very few fish were left in the reservoir. It appears that most of the fish migrated out through the bottom outlet of the dam and into Lucky Peak Reservoir,

Arrowrock - Tributary Survey

Major tributary streams to Arrowrock Reservoir include the Middle Fork and South Fork of the Boise River, Willow Creek, Rattlesnake Creek, and Cottonwood Creek. All but the Middle and South Forks are very small and do not provide

significant areas of spawning and rearing habitat (Figure 1).

Table 3,. Gill net catches in Arrowrock Reservoir prior to low pool, 1967.

Species	6/28	7/5	7/25	8/8	8/14	8/15	8/18	Total	Percent Composition
Largescale sucker	3	9	8	4	21	48	24	117	34
Rainbow trout	0	2	0	0	3	33	23	61	18
Coho	0	0	0	1	8	38	7	54	16
Bridgelip sucker	0	0	12	2	5	16	17	52	15
Redside shiner	0	1	3	2	10	28	0	44	13
Squawfish	0	0	2	3	1	5	2	13	4
Chiselmouth	0	0	0	0	1	0	0	1	<1
Yellow Perch	0	0	1	0	0	0	0	1	<1
Whitefish	0	0	0	0	0	1	0	1	<1
Dolly Varden	0	0	0	0	0	1	0	1	<1
Total	3	12	26	12	49	170	73	345	100
Fish/Net-hour	.33	.34	.72	.40	2.04	3.78	4.87	1.78	---

6/28 - 2 nets; Surface set at mouth of Grouse Creek and bottom set 4 mile east of boat ramp; 9 net-hours.

7/5 - 2 nets; Surface set at mouth of Grouse Creek and surface set across from Grouse Creek; 35 net-hours.

7/25 - 3 nets: All surface sets—1/4 mile east of boat ramp, 1 mile above dam, and at confluence of Middle and South Forks; 36 net-hours.

8/8 - 2 nets: Both surface sets 1 mile above dam; 30 net-hours.

8/14 - 3 nets: All bottom sets--near dam, 1 mile above dam and in South Fork arm; 24 net-hours.

8/15 - 3 nets; All bottom sets-near dam, in South Fork arm, and in Middle Fork arm; 45 net-hours,

8/18 - 3 nets: Bottom set near dam; surface sets in South Fork arm and at confluence of Middle and South Forks; 15 net-hours,

Total net-hours - 194.

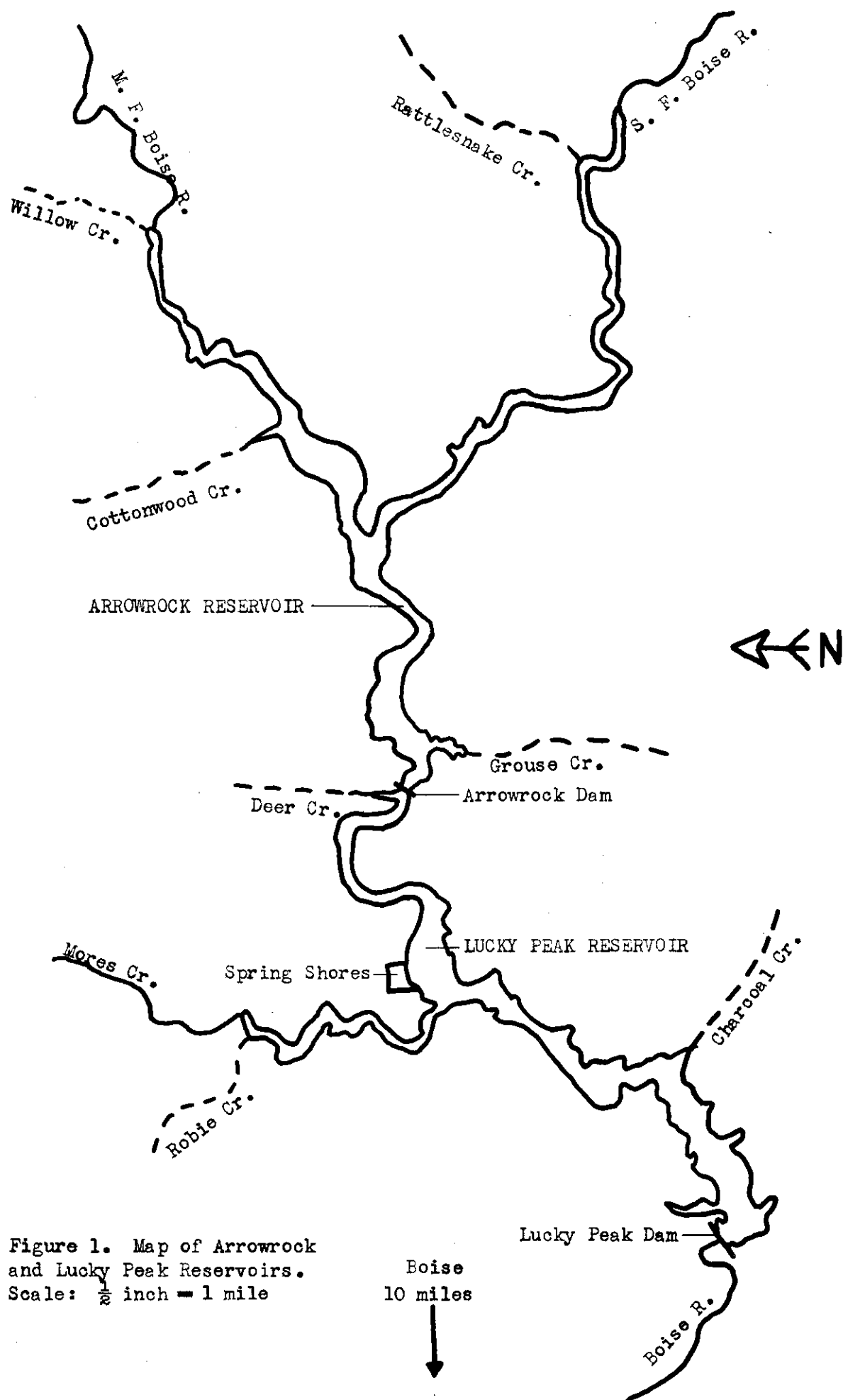


Figure 1. Map of Arrowrock and Lucky Peak Reservoirs.
Scale: $\frac{1}{2}$ inch = 1 mile

Table 4. Gill net catch in Arrowrock Reservoir during refill, 1967.

Species	10/11	10/16	11/7	11/8	Total	Percent Composition
Bridgelip sucker	0	0	0	1	1	33 1/3
Dolly Varden	0	0	0	1	1	33 1/3
Redside shiner	1	0	0	0	1	33 1/3
Total	1	0	0	2	3	100
Fish/Net-hour	0.22	0	0	0.09	0.06	---

10/11 - 1 net: Bottom set in South Fork arm; 4½ net-hours. 10/16 - 1 net:

Bottom set near dam; 4½ net-hours. 11/7 - 1 net: Surface set near dam;

21 net-hours.

11/8 - 1 net: Bottom set in South Fork arm; 23½ net-hours. Total net-hours

- 53½

No work was done on this phase of the project until July 1, 1967, because the biologist on the project left and another was not assigned until then. During the months of July and August, sections of the lower 15 miles of the Middle Fork were sampled with explosives. Large, adult suckers were the predominant fish, and only two rainbow trout (both hatchery fish) were found (Table 5).

Table 5. Fish killed by explosives in the Middle Fork of the Boise River, 1967.

Species	7/20	8/1	8/22	Total	Percent Composition
Largescale sucker	15	52	22	89	53
Bridgelip sucker	18	4	4	26	15
Rainbow trout	0	2	0	2	1
Redside shiner	7	4	37	48	29
Mountain whitefish	1	0	0	1	0.66
Mountain sucker	1	0	0	1	0.66
Speckled dace	1	0	0	1	0.66
Total	43	62	63	168	100

From this data it appears that the Middle Fork is possibly a significant source of suckers to the reservoir, and produces few trout.

The South Fork of the Boise is quite inaccessible and is unsuitable for sampling by shocking or blasting; therefore, no data was collected on this stream. The best fishing in the reservoir, however, is near the mouth of the South Fork and the bulk of the catch is wild fish.

Lucky Peak - Species Composition

Webb (1964) used both explosives and gill nets to estimate the species composition of Lucky Peak Reservoir. Gill nets were also used to a limited extent in 1967. It appears that squawfish have become more numerous in recent years (Tables 6 and 7). Coho salmon fingerlings were introduced in April, 1967, and had reached about eight inches in length by September. They made up 2 percent of the gill net catch.

Table 6. Estimated fish kill resulting from underwater explosions, Lucky Peak Reservoir, July, 1962 (Webb, 1964)e

Species	Number	Percent of Total
Suckers	11,695	43.0
Redside shiner	11,333	42.0
Squawfish	2,980	11.0
Whitefish	360	1.3
Yellow Perch	335	1.2
Trout	295	1.1
Chiselmouth	125	0.5
Tui chub	2	0.007

Table 7. Gill net catches in Lucky Peak Reservoir, 1964 and 1967.

Species	7/5	8/8	10/26	Total	Percent Composition	Total	Percent Composition
Squawfish	57	48	0	105	58	75	36
Largescale sucker	26	27	0	53	29	99	48
Rainbow Trout	2	1	4	7	4	4	2
Redside shiner	0	3	2	5	3	24	12
Chiselmouth	0	4	0	4	2	1	1
Yellow perch	0	0	0	0	0	3	1
Coho salmon	0	0	3	3	2	-	-
Chubs	1	2	0	3	2	1	1
Kokanee	0	0	1	1	1	0	0
Total	86	85	10	181	100	207	100
Fish/Net-hour	6.37	7.08	2.50	6.14	---	---	---

* 7/5 Surface set 2 miles above dam for 13½ hours.

8/8 - Surface set 3 miles above Spring Shores Marina for 12 hours,

10/26 - Surface set 300 yards above dam for 4 hours. Total net-hours - 29 ½

Lucky Peak - Tributary Survey

The only tributary of consequence to Lucky Peak Reservoir, other than Arrowrock Reservoir outflow, is Mores Creek. This tributary contains rainbow trout, whitefish, and several species of rough fish (Figure 1).

Spawning runs of suckers and squawfish are known to use Mores Creek, but high water in the spring makes enumeration impossible.

Food Habits Study

Arrowrock and Lucky Peak Reservoirs contain the same types of fish food organisms in approximately the same relative amounts; that is, they contain zooplankton (mostly *Dahnia*), numerous minnows, and a few insects. Nothing else in either reservoir is abundant enough to be considered an important food item.

Heiser analyzed stomach contents of 356 fish from Arrowrock in 1966. Six species were examined. The main food item for rainbow trout, squawfish, and yellow perch was found to be fish. Suckers and chiselmouth fed mainly on zooplankton (Table 8).

In 1967, stomach contents of rainbow trout and coho salmon from Lucky Peak were analyzed. Zooplankton was the predominant food organism for both species (Table 9).

Table 8. Percentage by volume of the stomach contents of 356 fish of six species in Arrowrock Reservoir, 1966.

Species	Zooplankton	Insect	Fish	Miscellaneous*
Largescale sucker	76%	8%	0%	16%
Bridgelip sucker	89	1	1	9
Squawfish	13	1	84	2
Rainbow trout	15	8	71	6
Yellow perch	0	0	60	40
Chiselmouth	100	0	0	0

*Rocks, wood, unidentified material

Table 9. Percentage by volume of the stomach contents of sixteen rainbow trout and fifteen coho salmon in Lucky Peak Reservoir, 1967.

Species	Zooplankton	Insect	Fish	Miscellaneous*
Rainbow Trout	54%	25%	10%	12%
Coho Salmon	69	14	9	9

*Rocks, wood, unidentified material

An attempt was made to analyze stomach contents of fish caught in gill nets in Arrowrock in 1967, but nearly all the stomachs were empty. There was plenty of food in the reservoir and the fish were in good condition, so it is assumed that they regurgitated their stomach contents after being caught.

Management of Arrowrock and Lucky Peak

The practice until recent years was to make large plants of rainbow trout fry and fingerlings (Tables 10 and 11). Recently, catchables have made up a larger portion of the plant, and in 1967, only catchable-size rainbow trout and finger-ling coho salmon were planted in both reservoirs.

Condition of Game Fish

In mid-August, condition factors were calculated from length and weight data of rainbow trout and coho salmon taken at Arrowrock Reservoir. The co-efficient of condition (K factor) is the most widely used measure of the plumpness of fish. It is calculated by the formula:

$$K = \frac{W \times 10^5}{L^3}$$

W = Average weight in grams; L = Average total length in millimeters.

Average length for 23 rainbow trout was 226 millimeters; average weight was 137 grams; and the coefficient of condition was K=1.2. Average length for 37 coho was 169 millimeters; average weight was 48 grams; and the coefficient of condition was K=1.0.

Table 10. Arrowrock Reservoir hatchery fish planting summary, 1950 to 1967.

Year	Species	Size*	Number
1950	Rainbow	Fry	50,100
1951	"	Subcatchable	13,150
		Fingerling	99,180
1952	"	Fry	101,250
	Kokanee	"	91,500
1953	Rainbow	Fingerling	93,300
	Kokanee	Fry	100,000
1954	Rainbow	..	68,750
		Fingerling	31,710
	Kokanee	Fry	91,760
1955	Rainbow	"	137,900
		Subcatchable	12,800
	Kokanee	Fry	96,000
1956	No record of planting		
1957	Rainbow	Fingerling	196,000
1958	"	..	193,280
1959		"	234,500
1960	"		218,740
1961	..		147,280
1962		Fry	89,600
1963	No record of planting		
1964	Rainbow	Fingerling	153,600
1965	No record of planting		
1966	Rainbow	Fingerling	30,000
		Catchable	4,000
	Kamloops	Fingerling	43,160
1967	Rainbow	Catchable	6,000
	Coho	Fingerling	60,000

*Fry - less than 2"
 Fingerling - 2-4"
 Subcatchable - 4-7"
 Catchable - over 7"

Table 11. Lucky Peak Reservoir planting summary.

Year	Species	Size*	Number
1954	Rainbow	Fingerling	65,584
1955	"	Fry	96,000
		Fingerling	61,028
		Subcatchable	26,400
	Kokanee	Fry	82,320
1956	Rainbow	Fingerling	50,530
1957	No record of planting		
1958	Rainbow	Subcatchable	4,000
	"	Catchable	29,500
1959		Fingerling	289,600
		Subcatchable	23,200
	"	Catchable	34,100
1960		Fingerling	200,940
		Catchable	39,000
	Rainbow-Brown Hybrid	Fingerling	47,040
1961	Rainbow	Fry	75,600
	"	Catchable	40,000
1962		Fry	312,850
		Catchable	20,500
1963		Fry	201,000
		Catchable	19,950
	Kamloops		600
1964	Rainbow	Fingerling	105,600
		Catchable	45,860
1965	"	Fry	81,250
		Subcatchable	335,500
		Catchable	76,740
1966		Fingerling	30,000
		Catchable	28,984
	Kamloops	Fingerling	42,850
1967	Rainbow	Catchable	32,600
	Coho	Fingerling	40,000

*Fry - less than 2"
 Fingerling - 2-4"
 Subcatchable - 4-7"
 Catchable - over 7"

LIMNOLOGICAL INVESTIGATIONS OF ARROW ROCK AND LUCKY PEAK RESERVOIRS

ABSTRACT

Dissolved oxygen concentrations, temperature profiles, and zooplankton abundance were determined at regular intervals at Arrowrock Reservoir in 1965, 1966 and 1967, and at Lucky Peak Reservoir in 1966 and 1967. Chemical water analyses were performed periodically during all three years. All physical conditions in both reservoirs remained suitable for game fish production during the study period, except for an oxygen deficiency which occurred in Arrowrock in the fall of 1966 when the water was drawn down to an extremely low level.

RECOMMENDATIONS:

Since most of the desired information has been collected and since physical conditions are adequate for fish survival and growth, limnological investigations of Arrowrock and Lucky Peak Reservoirs should be discontinued.

OBJECTIVES:

To determine the pattern of water temperatures, dissolved oxygen concentrations, zooplankton abundance, and general water quality in the reservoirs and their tributaries.

TECHNIQUES USED:

Sampling was done biweekly throughout the field season in Arrowrock in 1965, 1966 and 1967. Sampling was done biweekly at Lucky Peak in 1966 and monthly in 1967. Two sampling stations were selected in both reservoirs. At Arrowrock, Station 1 was in the forebay of the dam and Station 2 was at the confluence of the Middle Fork and South Fork (Boise River) arms of the reservoir. At Lucky Peak, Station 1 was in the forebay of the dam and Station 2 was in mid-channel off Spring Shores Marina (Figure 1). Since there was little difference in the data collected, only data from Station 1 on each reservoir is included in this report.

Water Temperature

Water temperatures were measured at all sampling depths with an electronic thermometer. The electronic unit was checked periodically for accuracy with a pocket thermometer.

Dissolved Oxygen

Water samples for dissolved oxygen analyses were collected with a 400 cc. Kemmerer brass sampling bottle. The modified Winkler Method was used for oxygen fixation. Heiser, in 1965 and 1966, used Hach Chemical Company dry, premeasured manganous-sulfate, alkali-iodide, and concentrated sulfuric acid to fix the samples, and a Bausch and Lomb spectrophotometer for analysis. In 1967, the entire oxygen determination was done with the Hach Chemical Company field kit.

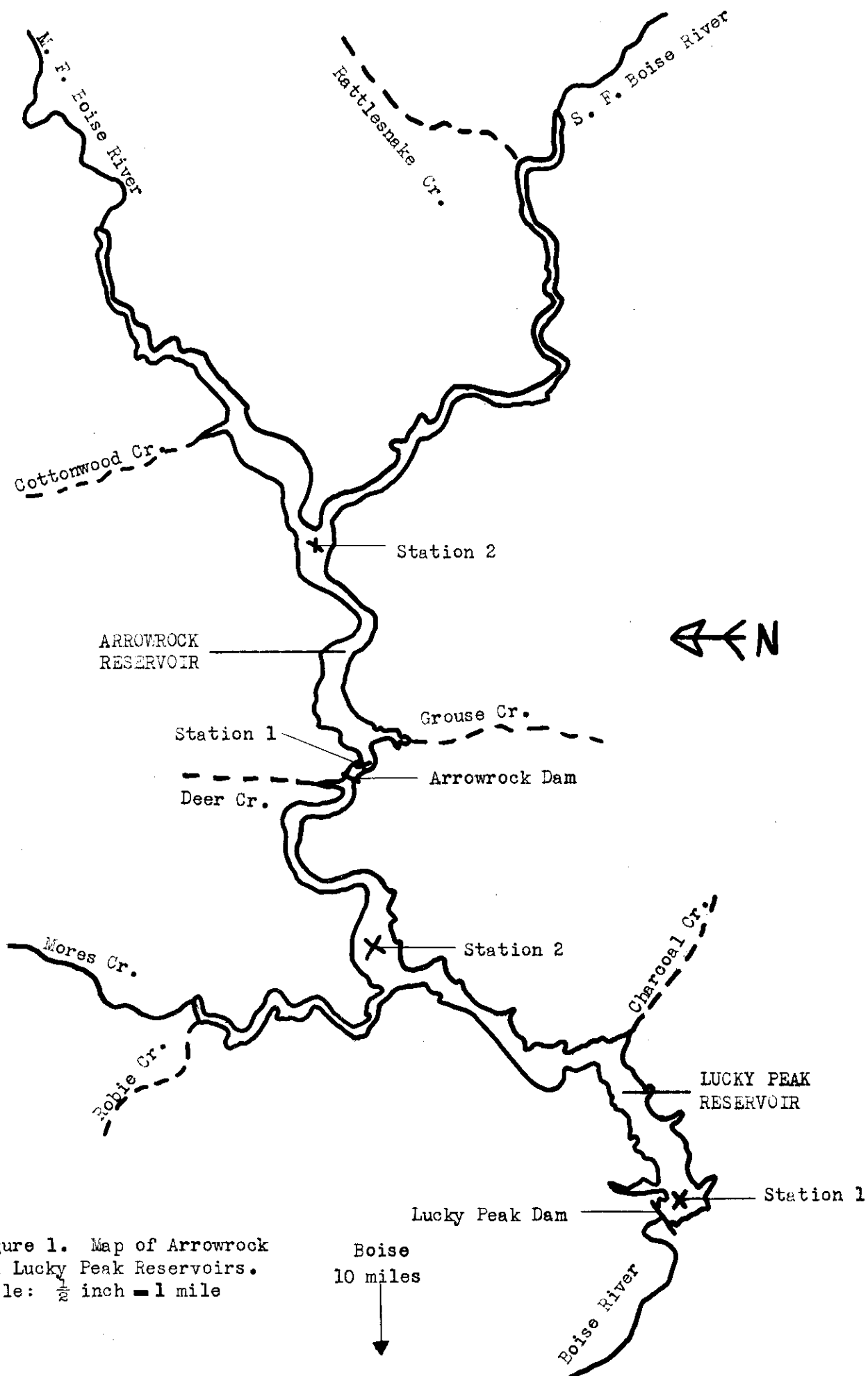


Figure 1. Map of Arrowrock and Lucky Peak Reservoirs.
Scale: $\frac{1}{2}$ inch = 1 mile

water Chemistry

The pH, alkalinity, hardness, ortho-phosphates, and total dissolved solids of both reservoirs were determined. Heiser did all analyses in 1965 and 1966 with Hach field kits and/or a spectrophotometer. In 1967, water samples were sent to the Idaho State Health Department for analysis.

Plankton

A three-liter Kemmerer brass sampling bottle was used to collect plankton. The sample was filtered through a survey plankton net with extra fine silk mesh. Each of the concentrates was placed in a separate marked bottle for storage until analysis could be performed.

Analysis was limited to enumeration of cladocerans, mainly Daphnia, because they were by far the largest and most abundant zooplankters present, and of prime importance as food for game fish. A one milliliter portion of each concentrate was placed in a Sedgewick-Rafter counting cell, and the total number of Daphnia counted. The enumeration was performed twice on each sample and the average number of Daphnia per liter of water was calculated.

FINDINGS:

Water Temperature

Water temperatures in Arrowrock and Lucky Peak remained quite compatible to fish life throughout 1965, 1966 and 1967 (Figures 2, 3, and 4). The reservoir begins to stratify in April and becomes nearly homothermos again by October. During the study period, the maximum peak surface temperature was 24° C (76° F).

Lucky Peak remains nearly homothermos at all times throughout the summer (Figures 5 and 6) due to high inflow and outflow, The maximum peak surface temperature encountered was 21.0 C (71° F).

Dissolved Oxygen

Except for the fall of 1966 when Arrowrock was drawn down to a very low level (Table 1) dissolved oxygen concentrations were consistently high (Figures 7, 8, and 9). At low pool in 1966, dissolved oxygen concentrations dropped to below 3 ppm and a fish kill was noted by Heiser (1967),

Dissolved oxygen remained near saturation at all times in Lucky Peak in 1966 and 1967 (Figures 10 and 11).

Water Chemistry

Chemical analyses of water samples from Arrowrock (Table 2) and Lucky Peak (Table 3) showed the reservoirs to be quite similar in water quality, i. e. . . , pH near neutral, low concentrations of total dissolved solids and ortho-phosphates, and low alkalinity and hardness.

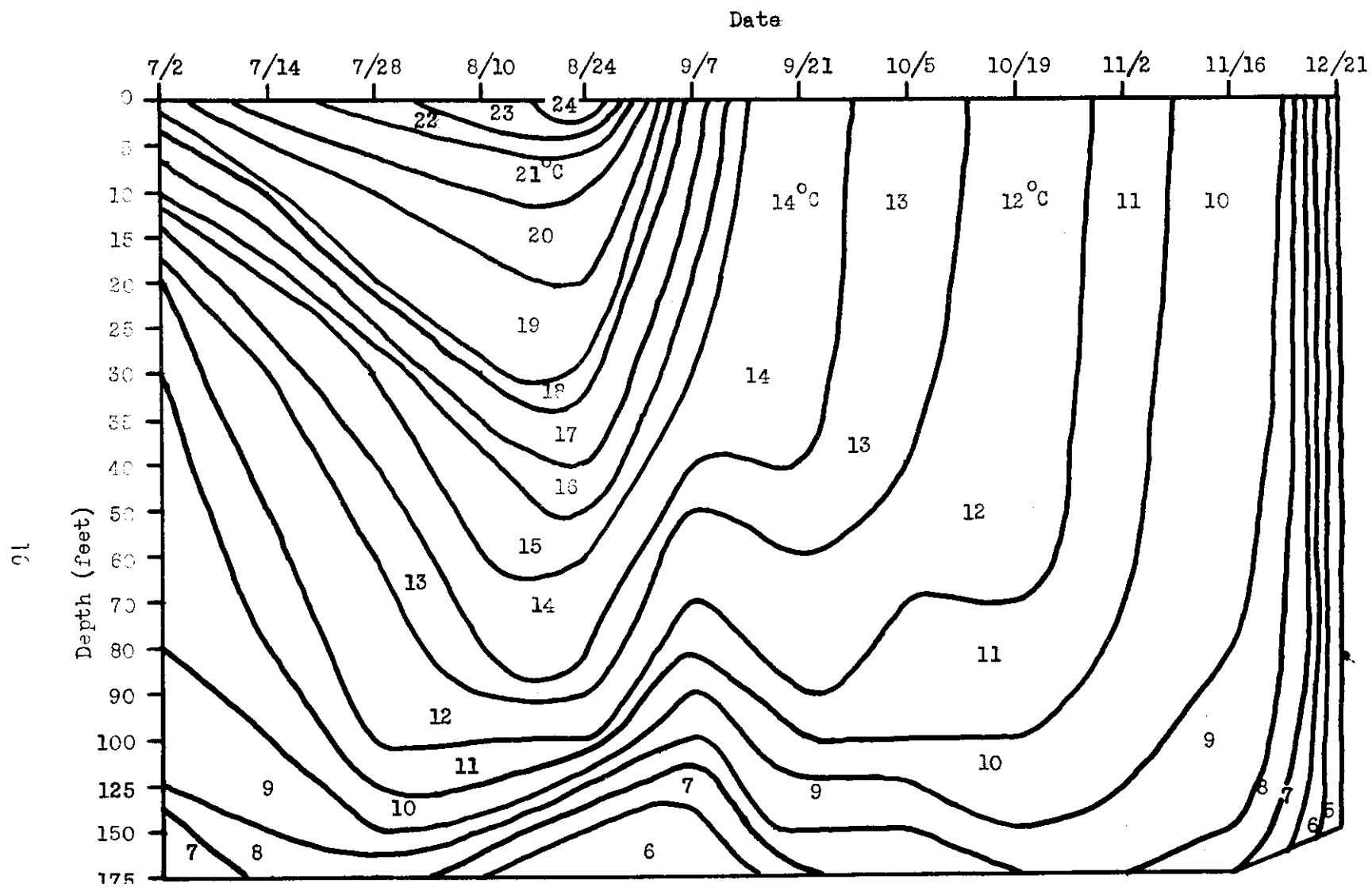


Figure 2. Temperature profile in Arrowrock Reservoir, 1965. (degrees Centigrade.)

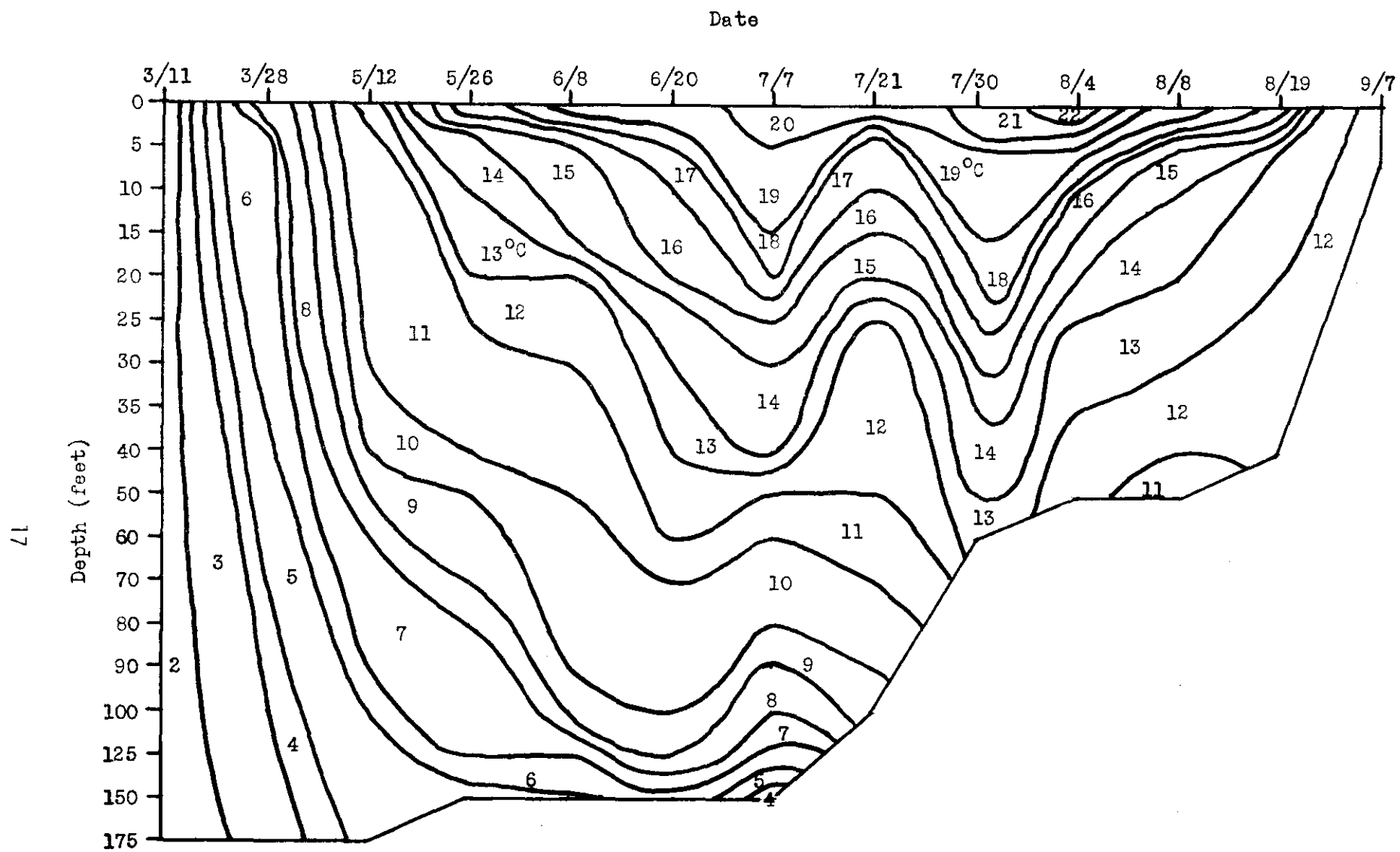


Figure 3. Temperature profile in Arrowrock Reservoir, 1966. (Degrees Centigrade.)

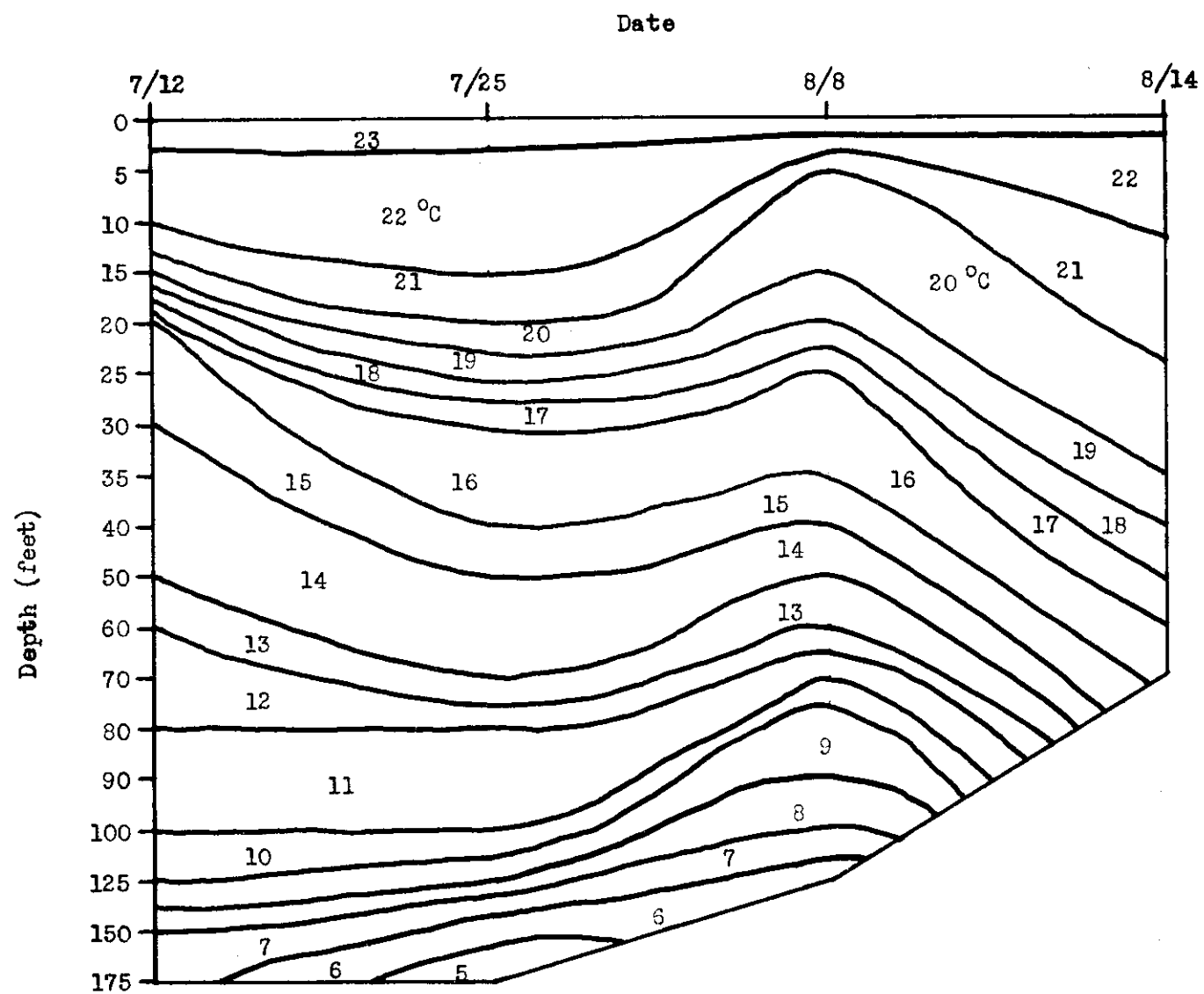


Figure 4. Temperature profile in Arrowrock Reservoir, 1967 (degrees Centigrade).

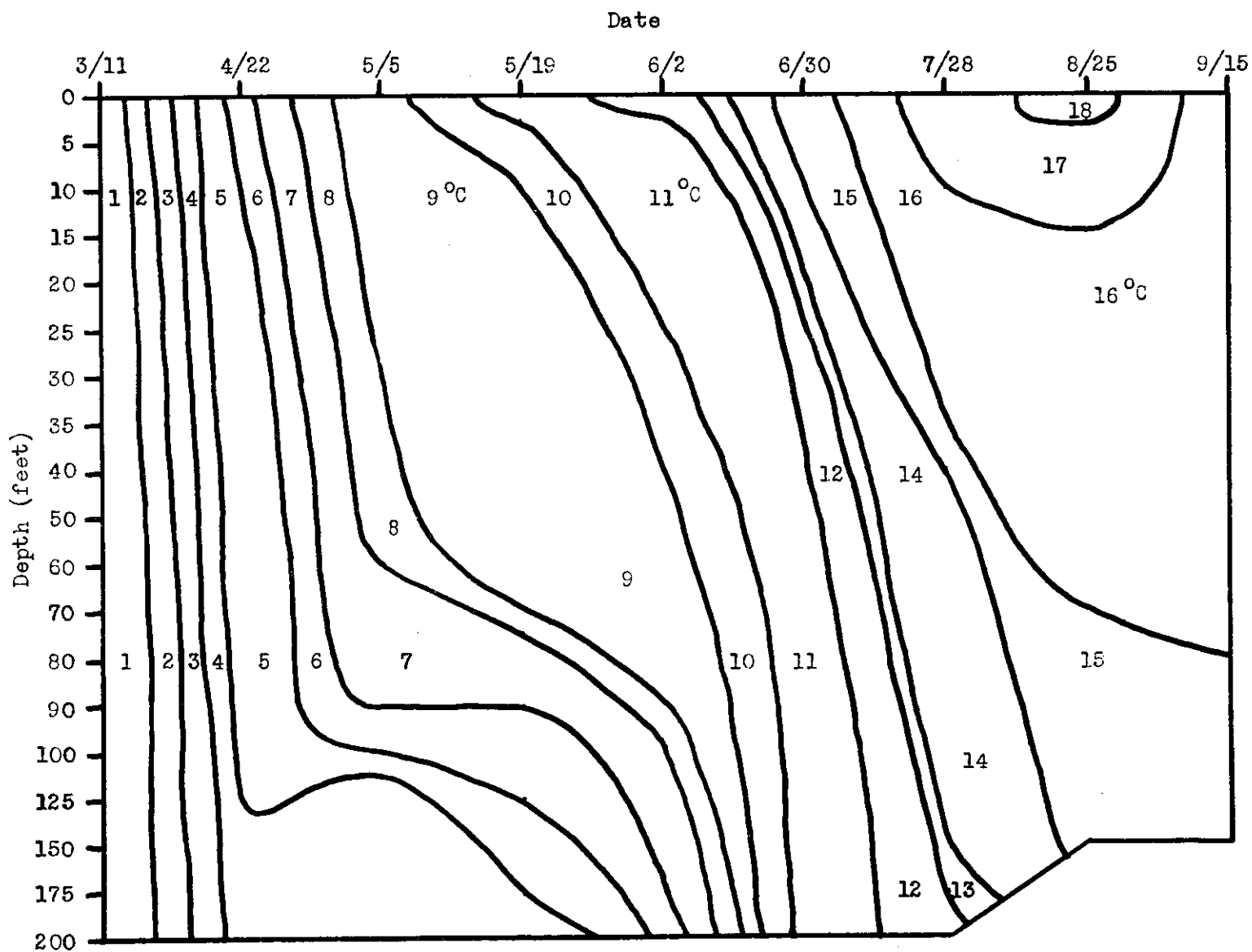


Figure 5. Temperature profile in Lucky Peak Reservoir, 1966 (Degrees Centigrade).

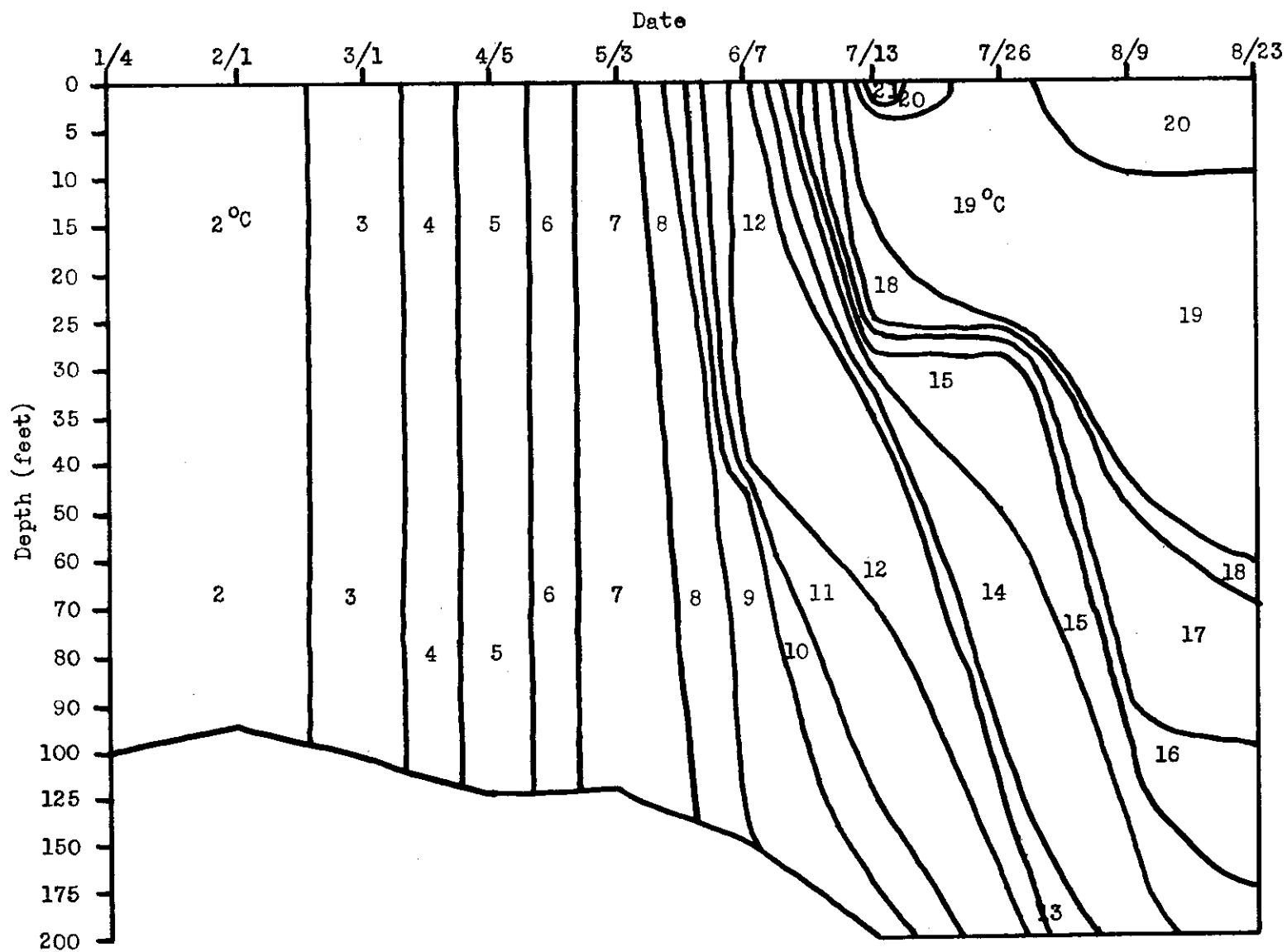


Figure 6. Temperature profile in Lucky Peak Reservoir, 1967 (Degrees Centigrade).

Table 1. Storage volumes of Arrowrock Reservoir, 1965 through 1967 (Acre-Feet).

Year	High	Low
1965	291,600	79,940
1966	286,000	
1967	283,500	1,120

Table 2. Water chemistry of Arrowrock Reservoir, 1965 through 1967.

	12/3/65	4/28/66	6/8/66	8/17/66	7/14/67
pH	7.3	7.4	7.1	6.8	6.9
Alkalinity (ppm CaCO ₃)	68	30	24	34	36
Hardness (ppm CaCO ₃)	32	26	24	40	35
Ortho-phosphates (ppm)	0.84	0.36	0.66	.10	0.10
Total dissolved solids (ppm)	104.0	37.0	5.9	25.9	34.0

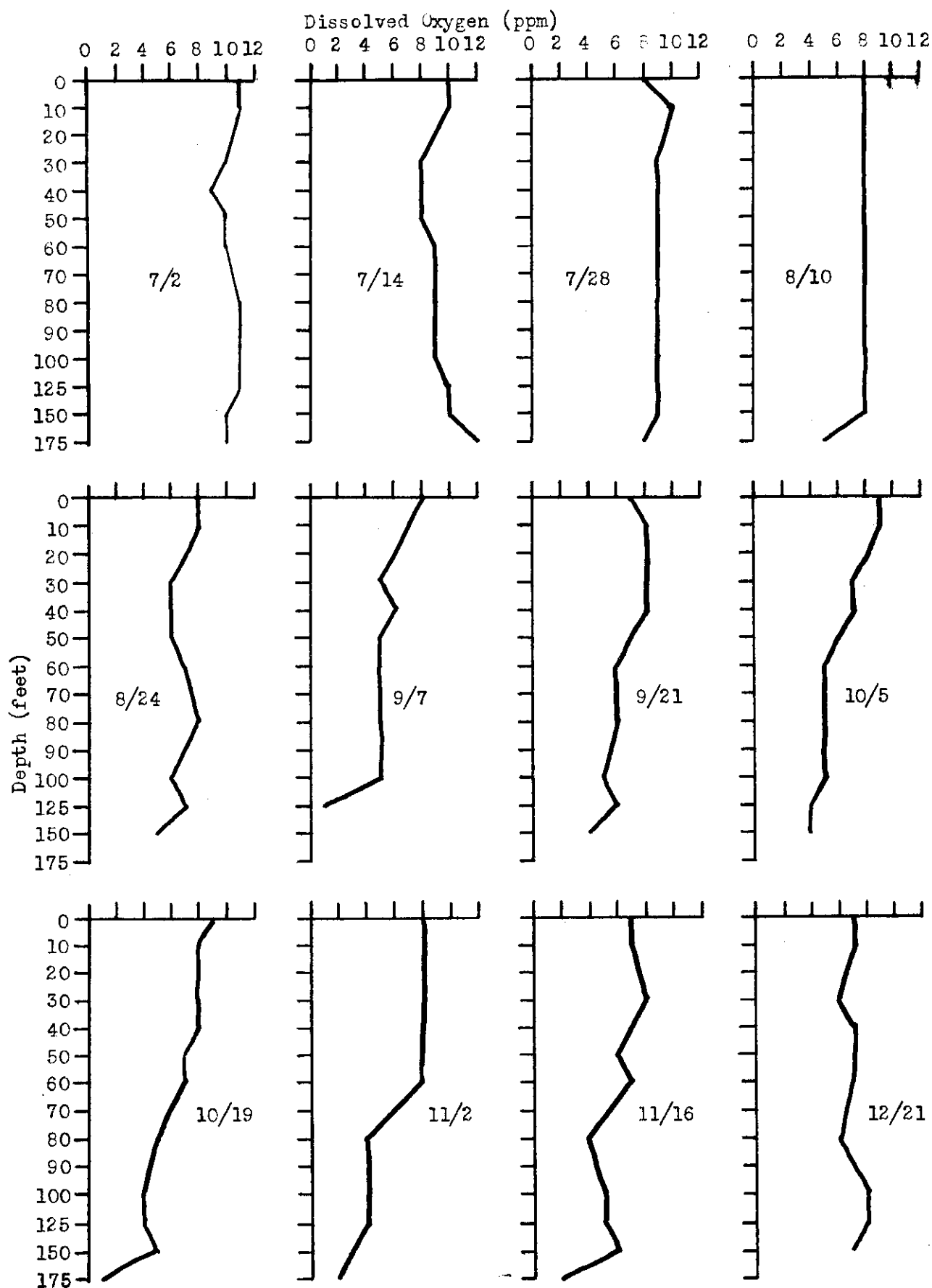


Figure 7. Dissolved oxygen concentrations in Arrowrock Reservoir, 1965.

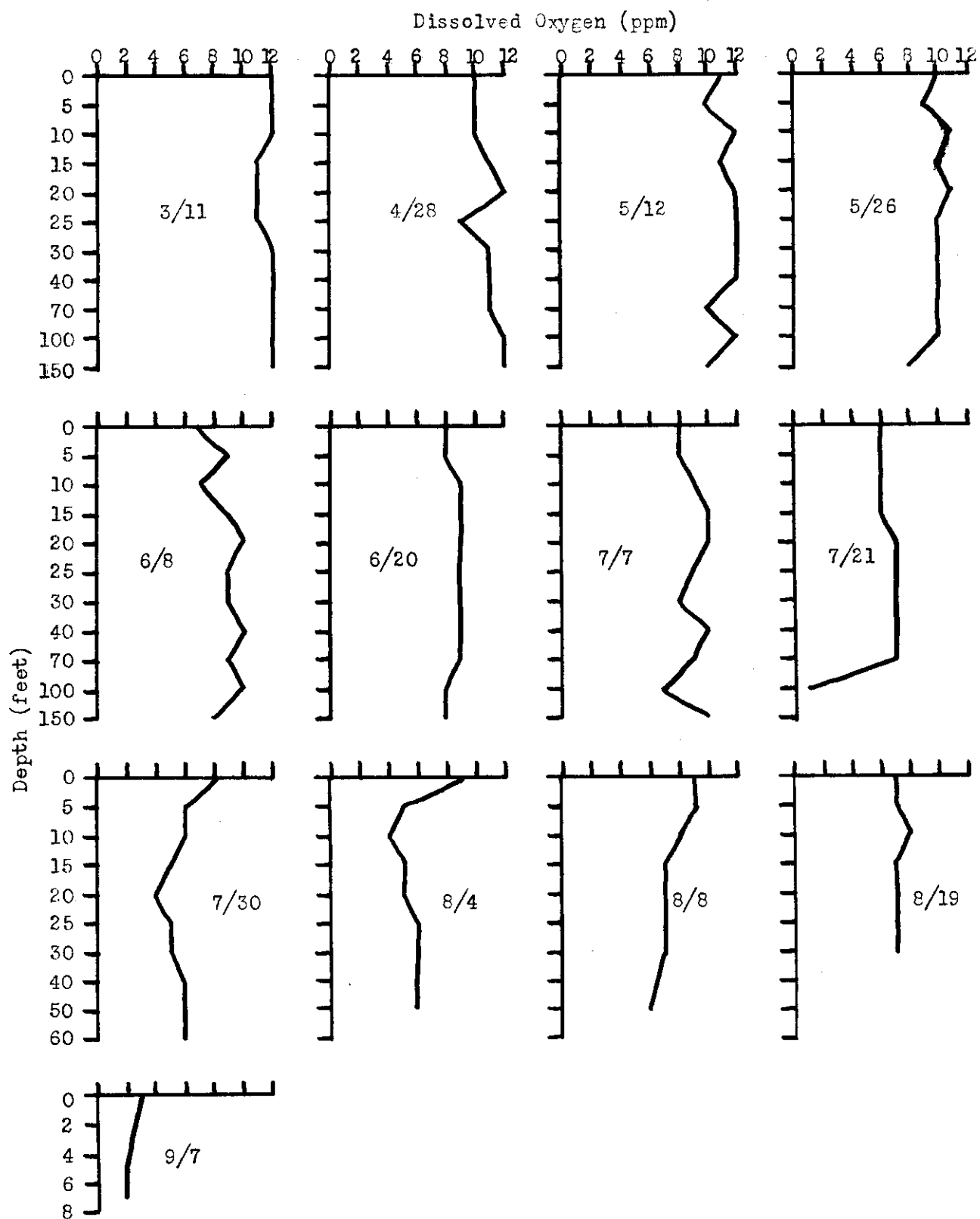
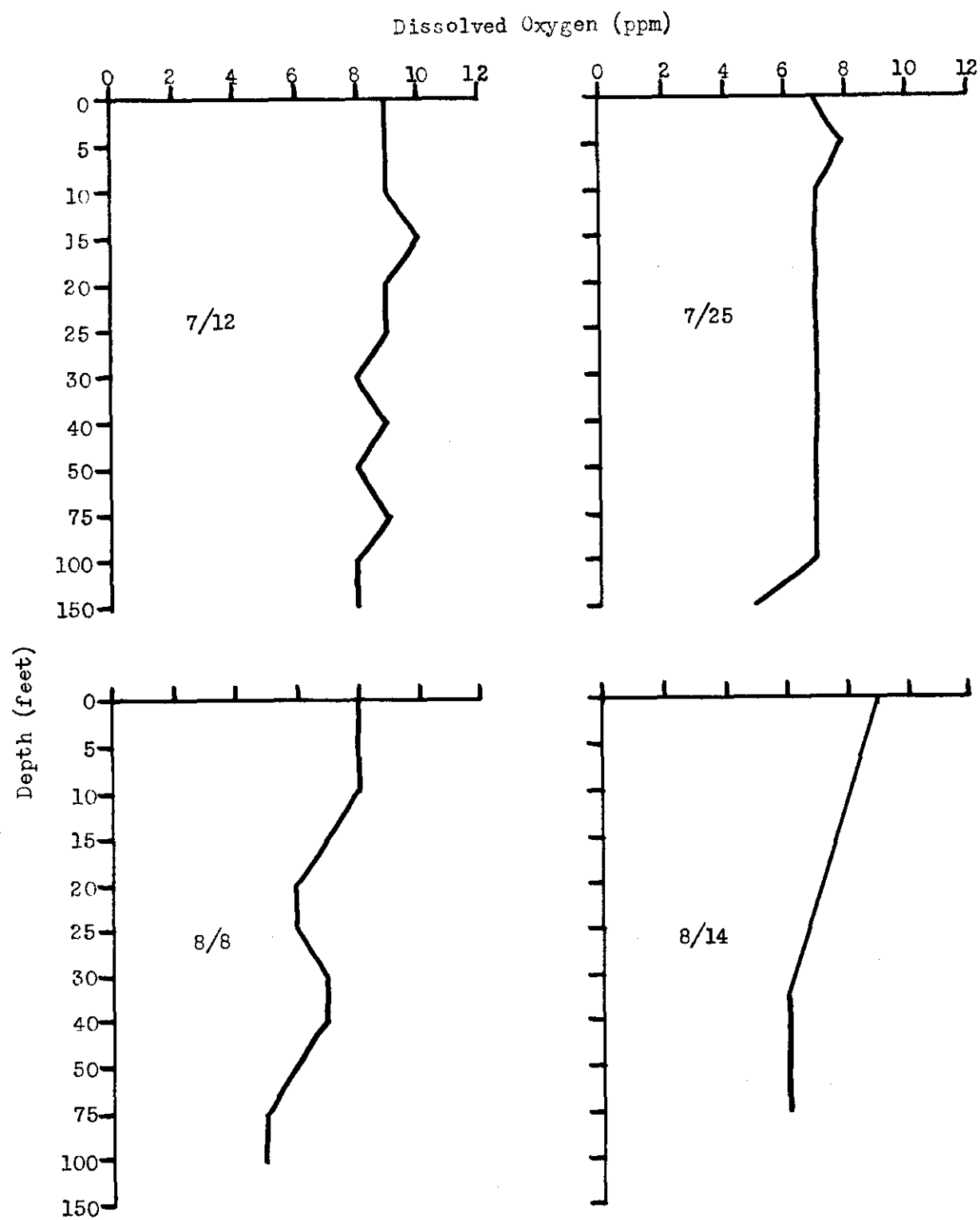


Figure b. Dissolved oxygen concentrations in Arrowrock Reservoir, 1966. 23



Surface only: 9/12 - 7 ppm; 9/20 - 8 ppm; 10/10 - 9 ppm.

Figure 9. Dissolved oxygen concentrations in Arrowrock Reservoir, 1967. 24

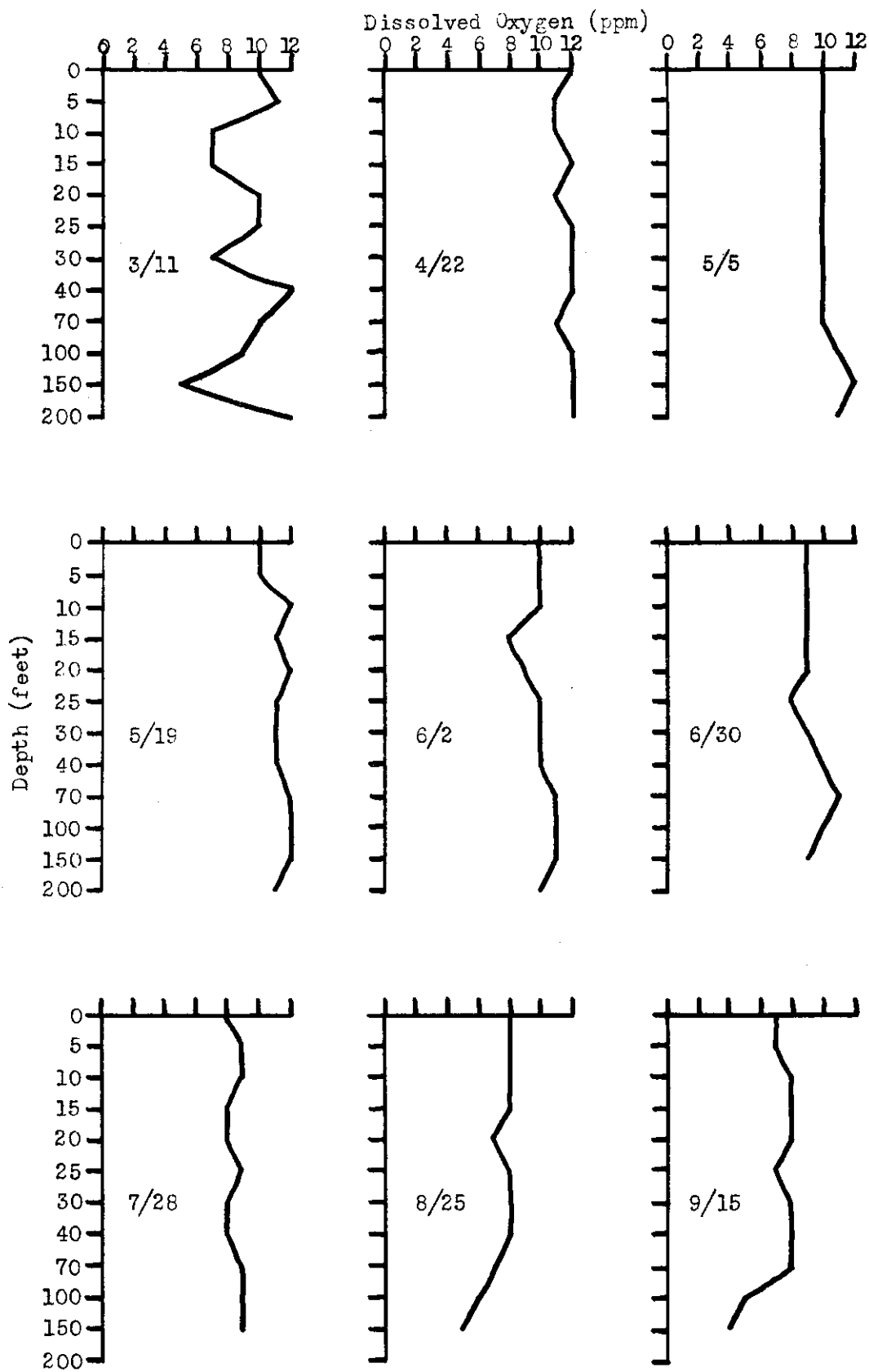


Figure 10. Dissolved oxygen concentrations in Lucky Peak Reservoir,

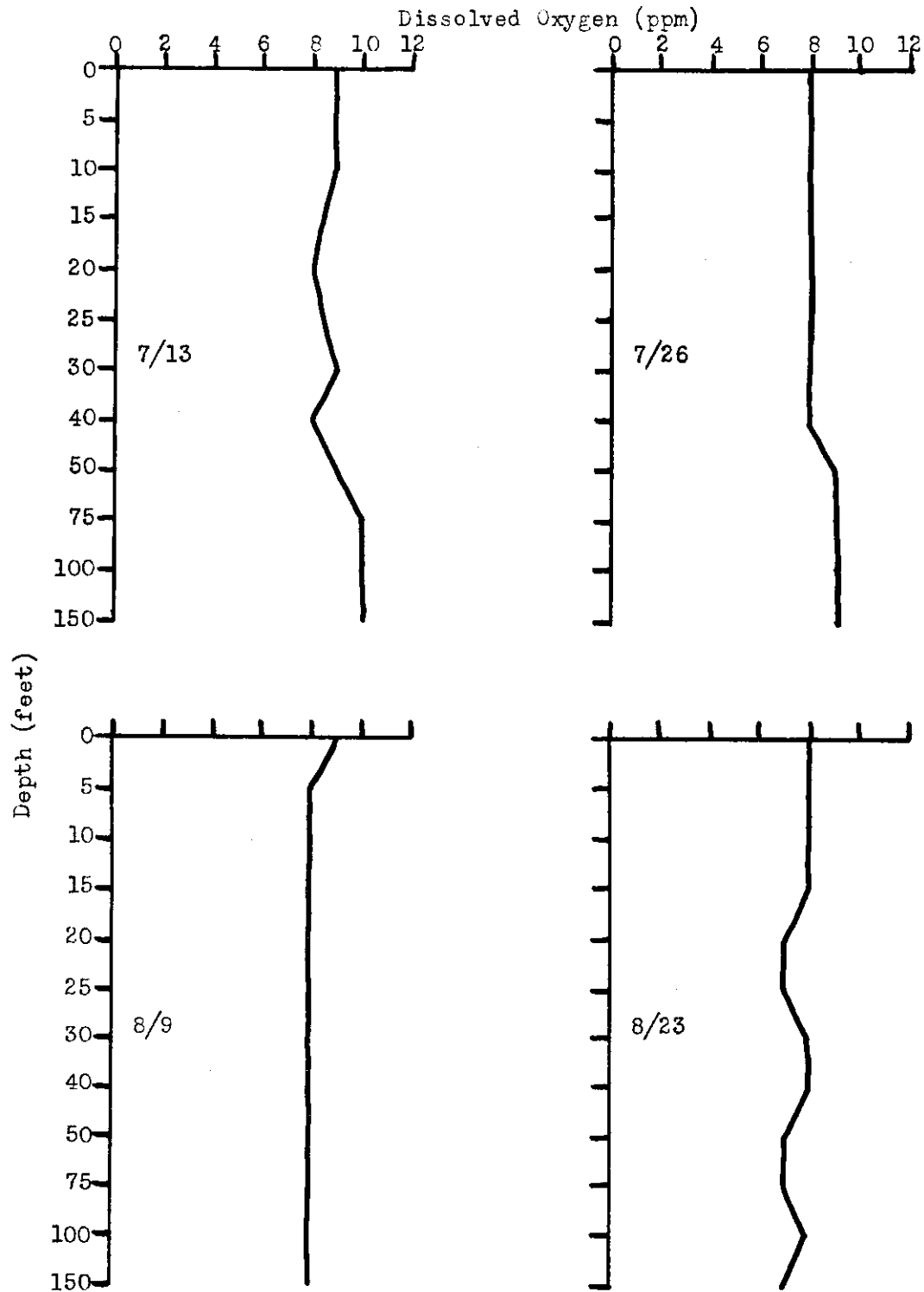


Figure 1. Dissolved oxygen concentrations in Lucky Peak Reservoir, 1967. 26

Plankton

Daphnia was found to be the most important and most plentiful zooplankter in both Arrowrock and Lucky Peak Reservoirs. Other cladocerans, copepods, rotifers, and diatoms were also present, but in small numbers.

Table 3. Water chemistry of Lucky Peak Reservoir, 1966 and 1967.

	4/22/66	6/17/66	8/17/66	7/14/67
pH	7.5	7.4	7.1	6.9
Alkalinity (ppm CaCO ₃)	26.0	30.0	38.0	36.0
Hardness (ppm CaCO ₃)	24.0	34.0	30.0	35.0
Ortho-phosphates (ppm)	0.44	0.34	0.62	0.10
Total dissolved solids (ppm)	5.9	20.7	8.9	34.0

Daphnia are present in concentrations in excess of 10 organisms per liter from May to September in both reservoirs (Figures 12 and 13). May and June seem to be the months of greatest abundance. Heiser (1966) also reported a high Daphnia pulse in November of 1965.

During periods of low pool in both reservoirs, zooplankton practically disappears and remains at low levels of abundance into the winter.

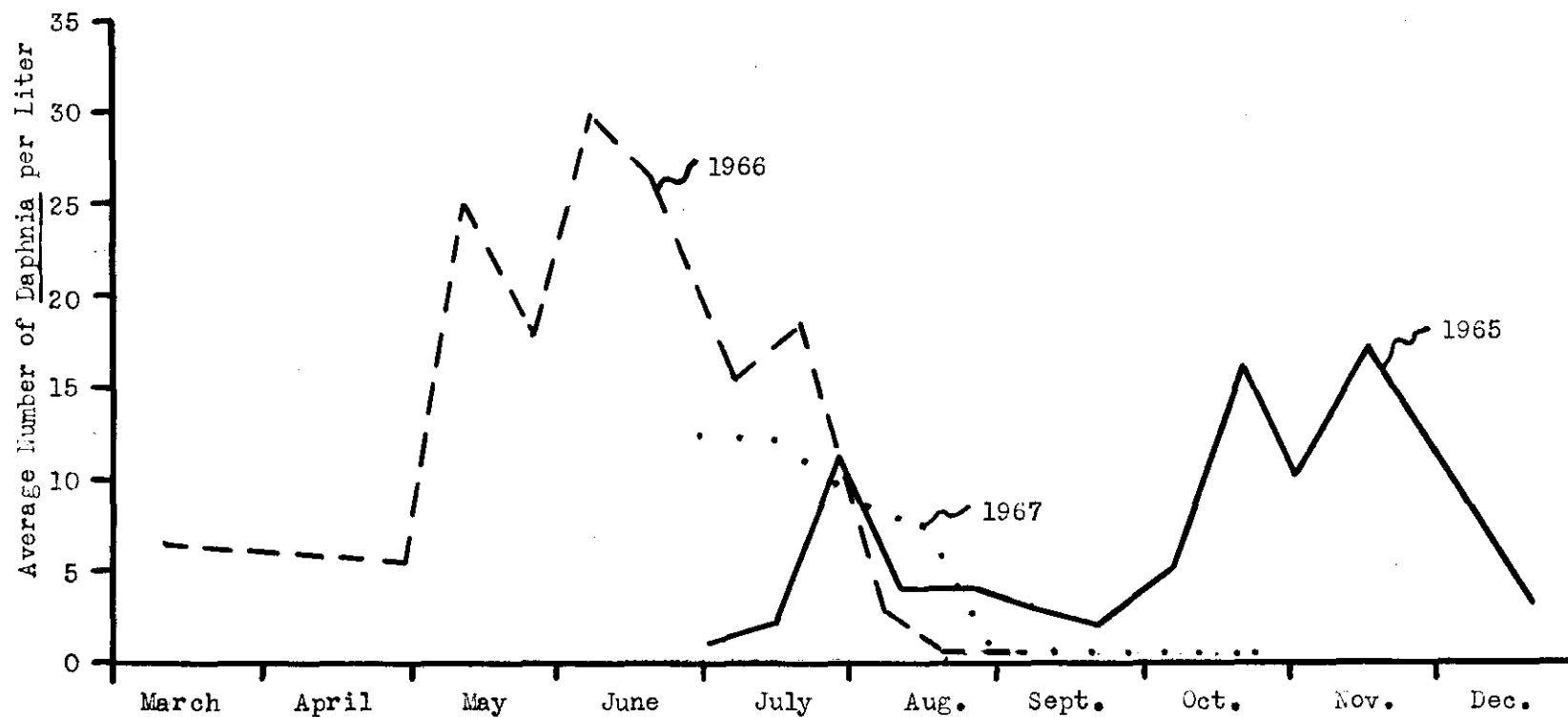


Figure 12. Daphnia pulses in Arrowrock Reservoir, 1965 through 1967.

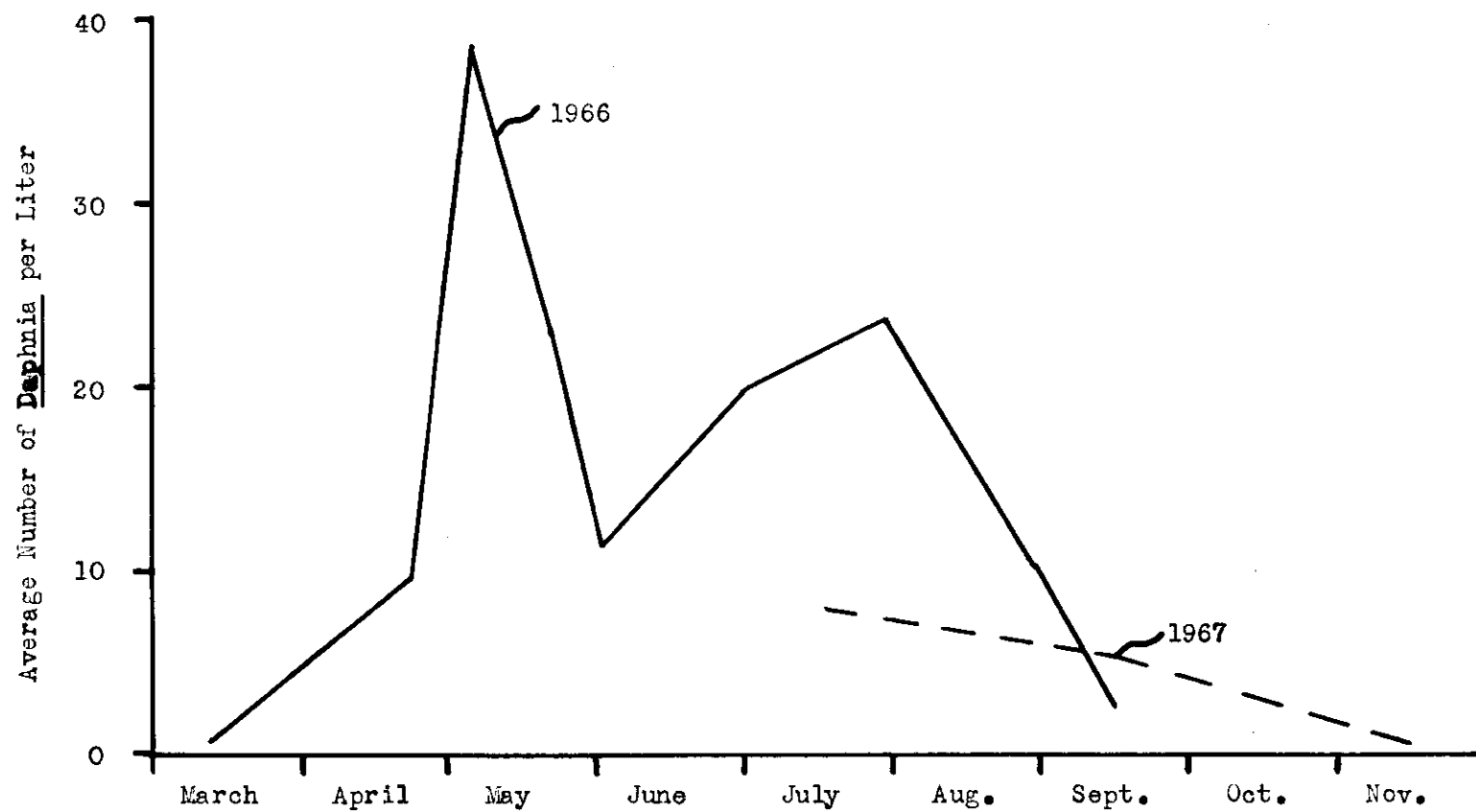


Figure 13. Daphnia pulses in Lucky Peak Reservoir, 1966 and 1967.

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Prepared by:

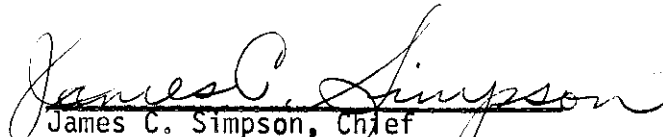
Donald J. Welch
Fishery Biologist


February, 1968

Approved by:

IDAHO FISH AND GAME DEPARTMENT


John R. Woodworth
Director


James C. Simpson, Chief
Fisheries Management Division


Vernon B. Rich, Coordinator
IDAHO FEDERAL AID